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A.	For $n=0, 2, 4, 6$, etc.						
	$\lambda=$	1	3	5	7	9	etc.
	$x=$	1 2	4 5	7 8	10 11	13 14	
	For $n=1, 3, 5, 7$, etc.						
	$\lambda=$	0	2	4	6	8	
	$x=$	$-\frac{1}{2} \frac{1}{2}$	$\frac{5}{2} \frac{7}{2}$	$\frac{11}{2} \frac{13}{2}$	$\frac{17}{2} \frac{19}{2}$	$\frac{23}{2} \frac{25}{2}$	

$$y = n \sin \frac{1}{2} \pi.$$

Similarly for negative values of n, λ .

MECHANICS.

96. Proposed by **GEORGE R. DEAN**, Professor of Mathematics, University of Missouri School of Mines and Metallurgy, Rolla, Mo.

Two particles, subject to their mutual attraction and that of a fixed center, move in a plane containing the center. Find the motion under the law of the inverse square.

Solution by **G. B. M. ZERR**, A. M., Ph. D., Professor of Mathematics and Science, Chester High School, Chester, Pa.

Take the center of force as origin. Let m, m_1, m_2 be the masses of the center of force and particles, respectively. r, r_1, ρ the distances of the particles from the center of force and from each other, respectively. $(x, y), (x', y')$ the coördinates of the particles. The differential equations of motion of the two particles relative to the center of force are

$$\left. \begin{aligned} \frac{d^2 x}{dt^2} &= -\frac{m+m_1}{r^3}x + \frac{x'-x}{\rho^3}m_2 - \frac{m_2 x'}{r_1^3} \\ \frac{d^2 y}{dt^2} &= -\frac{m+m_1}{r^3}y + \frac{y'-y}{\rho^3}m_2 - \frac{m_2 y'}{r_1^3} \end{aligned} \right\} \dots (1).$$

$$\left. \begin{aligned} \frac{d^2 x'}{dt^2} &= -\frac{m+m_2}{r_1^3}x' + \frac{x-x'}{\rho^3}m_1 - \frac{m_1 x}{r^3} \\ \frac{d^2 y'}{dt^2} &= -\frac{m+m_2}{r_1^3}y' + \frac{y-y'}{\rho^3}m_1 - \frac{m_1 y}{r^3} \end{aligned} \right\} \dots (2).$$

Where $\rho = \sqrt{[(x'-x)^2 + (y'-y)^2]}$.

Multiply (1) by $2m_1 \frac{dx}{dt} - 2m_1 \frac{m_1 \frac{dx}{dt} + m_2 \frac{dx'}{dt}}{m+m_1+m_2}$.

$$2m_1 \frac{dy}{dt} - 2m_1 \frac{m_1 \frac{dy}{dt} + m_2 \frac{dy'}{dt}}{m+m_1+m_2}.$$

Multiply (2) by $2m_2 \frac{dx'}{dt} - 2m_2 \frac{m_2 \frac{dx'}{dt} + m_1 \frac{dx}{dt}}{m + m_1 + m_2}$,

and $2m_2 \frac{dy'}{dt} - 2m_2 \frac{m_2 \frac{dy'}{dt} + m_1 \frac{dy}{dt}}{m + m_1 + m_2}$.

Adding the four products we get

$$\begin{aligned}
 & 2m_1 \left(\frac{dx}{dt} \cdot \frac{d^2x}{dt^2} + \frac{dy}{dt} \cdot \frac{d^2y}{dt^2} \right) + 2m_2 \left(\frac{dx'}{dt} \cdot \frac{d^2x'}{dt^2} + \frac{dy'}{dt} \cdot \frac{d^2y'}{dt^2} \right) \\
 & - 2 \frac{m_1 \frac{dx}{dt} + m_2 \frac{dx'}{dt}}{m + m_1 + m_2} \left(m_1 \frac{d^2x}{dt^2} + m_2 \frac{d^2x'}{dt^2} \right) \\
 & - 2 \frac{m_1 \frac{dy}{dt} + m_2 \frac{dy'}{dt}}{m + m_1 + m_2} \left(m_1 \frac{d^2y}{dt^2} + m_2 \frac{d^2y'}{dt^2} \right) \\
 & - 2m \left(\frac{m_1}{r^2} \frac{dr}{dt} + \frac{m_2}{r_1^2} \frac{dr_1}{dt} \right) - 2 \frac{d}{dt} \left(\frac{m_1 m_2}{\sqrt{[(x' - x)^2 + (y' - y)^2]}} \right) = 0.
 \end{aligned}$$

Integrating we get

$$\begin{aligned}
 & m_1 [(dx/dt)^2 + (dy/dt)^2] + m_2 [(dx'/dt)^2 + (dy'/dt)^2] \\
 & - \frac{[(m_1 dx/dt + m_2 dx'/dt)^2 + (m_1 dy/dt + m_2 dy'/dt)^2]}{m + m_1 + m_2} \\
 & - 2m \left(\frac{m_1}{r} + \frac{m_2}{r_1} \right) - \frac{2m_1 m_2}{\sqrt{[(x' - x)^2 + (y' - y)^2]}} = A,
 \end{aligned}$$

$$\begin{aligned}
 & \text{or } mm_1 [(dx/dt)^2 + (dy/dt)^2] + mm_2 [(dx'/dt)^2 + (dy'/dt)^2] \\
 & + m_1 m_2 [(dx'/dt - dx/dt)^2 + (dy'/dt - dy/dt)^2] \\
 & - 2(m + m_1 + m_2) \left[m \left(\frac{m_1}{r} + \frac{m_2}{r_1} \right) + \frac{m_1 m_2}{\sqrt{[(x' - x)^2 + (y' - y)^2]}} \right] = A.
 \end{aligned}$$

The *vis viva* equation of motion.